Before the
Federal Communications Commission
Washington, DC, 20554

In the matter of Amendment of Part 97 of the Commission's Amateur Radio Service Rules to Reduce Interference and Add Transparency to Digital Data Communications	RM-11831
Amendment of Part 97 of the Commission's Amateur Radio Service Rules to Permit Greater Flexibility in Data Communications	WT Docket No. 16-239 RM-11708

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Comment of Bruce Perens

1 Expert Status

I am a Federal-Court-admitted expert regarding one of the issues at hand, and have special expertise regarding another:

1. I am co-founder of the Open Source movement in software (see https://en.wikipedia.org/wiki/Bruce_Perens). Mr. Kolarik, in his request initiating RM-11831, calls for Open Source decoding tools, and Open interfaces and protocols. I was accepted as an expert regarding Open Source by the Federal court in *Jacobsen v. Katzer* (US Court of Appeals for the Federal Circuit 2009-1221).
2. The matters referenced concern digital communications over Amateur Radio. I founded the *Codec2* project and recruited the main developer. This project created the *FreeDV* digital voice system for use on Amateur Radio (freedv.org, rowetel.com). This is the first deployed system for two-way radio communications to use neural networks in digital voice encoding, and technically exceeds other existing systems

for digital voice communications over radio: it uses less than half of the bandwidth of competing systems while delivering better voice quality.

2 Summary

I call for:

1. Language for 97.309(4) which supports the self-policing function of Amateur Radio as intended by Mr. Kolarik. However, Mr. Kolarik's proposed language regarding Open Source is problematical, so I propose replacement language which does not specify Open Source.
2. Dismissal of the rest of Mr. Kolarik's petition.
3. Removal of current language restricting Baud rate and symbol rate.
4. Imposition of a 2.8 kHz bandwidth limitation upon all digital Amateur modulation below 30 MHz, regardless of payload (textual, voice, etc.).

2.1 Disclosure and Rights, Rather Than Open Source, Are Necessary

The full disclosure of on-air protocols, and a grant of rights sufficient to allow their use over Amateur Radio for both transmission and reception, *are* necessary to support the self-policing function of Amateur Radio. However, Mr. Kolarik's well-intentioned proposal confuses these with Open Source.

Later in this comment, I propose appropriate text for modification of 97.309(4), as a replacement for Mr. Kolarik's proposal, implementing his intention without unnecessary conflation with Open Source.

2.2 A Bandwidth Limitation is Necessary.

I agree with the Commission that there is no further need for regulation of Baud rates and symbol rates. However, the absence of a bandwidth limitation, as the Commission currently proposes, would authorize inefficent and wasteful use of radio spectrum. Thus, I support ARRL's proposed limit. 2.8 kHz is an appropriate limit for *all digital modulations below 30 MHz,* regardless of whether their payload is textual, voice, or otherwise. Such a limitation would:

1. Allow PACTOR 4, which is a reasonably efficient digital text mode.

2. Continue the prohibition of HF use of inefficient digital voice modes like D*STAR, since more modern digital modes like FreeDV (https://freedv.org/) are already authorized and can carry a high quality voice signal within the proposed 2.8 kHz. The older D*STAR would require at least double that bandwidth for a similar voice signal, and thus would be excessively wasteful of precious HF bandwidth. D*STAR would remain authorized above 30 MHz, as it is today.
3. Establish a rough parity of operations, in which digital transmissions and SSB radiotelephone would use approximately the same bandwidth, with neither mode displacing *multiple* operations of the other.
4. Not impose a limitation on the few remaining analog modes wider than 2.8 kHz, mainly AM radiotelephone users. I hope that improved digital voice modes eventually attract them to become more efficient in their bandwidth use.

2.3 The PACTOR 2, 3, and 4 Issue Which Prompted The Petition No Longer Exists

One main reason for the submission of Mr. Kolarik's petition no longer exists. The compression tables used in PACTOR 2, 3, and 4 had been undisclosed and trade-secret, obscuring the meaning of transmissions using that protocol and placing the Amateurs who used those modes in violation of 97.309(b). However, SCS, manufacturer of PACTOR, has disclosed the tables in a document at https://www.p4dragon.com/download/PACTOR_Advanced_Data_Compression.pdf

With that disclosure, I do not at this time know of any further missing datum which would make it impossible to decode the PACTOR transmissions using independently developed software and a sound card, rather than the very expensive PACTOR hardware.

2.4 The National Security Issue Proposed Is Fanciful and Unsubstantiated

Recent comments in 16-239 propose a national security issue in PACTOR 2, 3, and 4 transmissions which could not be decoded by Radio Amateurs without the expensive PACTOR hardware. Communications supporting drug trafficing were mentioned in multiple comments *as if* they were an existing problem. They are not.

The *theory* behind such an allegation was that:

1. Such communications could go on within Amateur frequencies, although outside of Amateur regulation.
2. That Amateurs would not be able to decode them and determine that they were unlawful.
3. That since *normal* Amateur transmissions using PACTOR 2, 3, and 4 would be similarly un-decodable, that the hams would not be able to differentiate unlawful communications from legitimate Amateur use.

I agree that it's important for Amateurs to be able to decode Amateur transmissions, for the self-policing function of Amateur Radio to work. However, I have been unable to find any substantiation in the form of published court documents, or indeed any published government communication whatsoever, that documents any use of PACTOR or other Amateur Radio systems for drug running or any other unlawful purpose. However, there is frequent publication of the capture of drug boats and other drug smuggling operations.

2.5 Elimination of 97.221(b), Providing Frequencies for Automatically Controlled Digital Stations, is Unwarranted

Mr. Kolarik proposes to eliminate 97.221(b), which provides authorized frequencies for automatic stations using more than 500 Hz bandwidth. He gives as justification that the stations are difficult to identify. However, with the disclosure of the compression tables used in PACTOR 2, 3, and 4, it should be possible for current automatic stations to be monitored.

Mr. Kolarik accuses current automatic stations of being unable to determine if a frequency is occupied before they begin transmission. If this is the case, the station is already in violation of 97.101(b) and (d), which specify responsible frequency sharing. There should thus be appropriate enforcement, and the software should be repaired so that it listens before transmission. This is not, however, an excuse to disallow use of the authorized frequencies for automatic stations that *do* listen properly. Thus, I recommend that Mr. Kolarik's proposal to remove 97.221(b) be denied.

3 Discussion

3.1 Disclosure of On-Air Protocols and Rights Required to Implement Them are Necessary For The Self-Policing Nature of Amateur Radio

In its order DA-07-3069A1 (https://apps.fcc.gov/edocs_public/attachmatch/DA-07-3069A1.pdf), footnote 15, The Commission states:

> *We note that a hallmark of enforcement in the amateur service is "self-policing," which depends on an amateur station hearing a message being able to determine the call sign of the transmitting station. See, e.g., Waiver of Sections 97.80(b) and 97.114(b)(4) of the Amateur Rules to Permit the Retransmission of Third-Party Traffic in Certain Situations, Order, PR Docket No. 85-105, 59 Rad. Reg. (P & F) 1326, 1326 ¶ 2 (PRB 1986).*

Inherent in self-policing is the requirement that *many* and potentially *all* Radio Amateurs be capable of receiving a signal and decode its *entire* content, *not* simply the callsign, and if necessary make contact with the station. This is necessary because:

1. Any station which is interfered with should be able to identify the interfering station, contact it using the same mode and ask it to stop interfering, and if necessary document a complaint.
2. Decoding the entire content is necessary to determine whether the content of the transmission is compliant with Amateur Radio regulation. If the content is commercial in nature, obscene, or supports unlawful activity, Radio Amateurs should be able to document the violation and report it.
3. For a monitoring station to be able to receive the *entire* content of a digital text transmission which makes use of an automatic-repeat (“ARQ”) protocol, it must be close to the transmitter, or multiple monitoring stations must be used. Because of the nature of data compression, a missing piece of the received message may cause the entire transmission to be unreadable. While the intended receiving station can ask for a transmission to be repeated, the monitoring station can not. Thus, it is necessary for many, geographically-distributed, stations to be capable of monitoring.

Mr. Kolarik proposes this language to implement self-policing of digital modes as 97.309(4):

> *An amateur station transmitting a RTTY or data emission using a digital code specified in this paragraph may use any technique whose technical characteristics have been documented publicly, and the protocol used can be be monitored, in it's entirety, by 3rd parties, with freely available open source software, for the purpose of facilitating communications.*

I would be gratified for all software in Amateur Radio to be Open Source. Indeed I'd like all of the software in the world to be Open Source. But Open Source is not strictly necessary merely to support the self-policing function of Amateur Radio.

Fortunately, we can facilitate Amateur self-policing with different language which does not mention Open Source. I propose:

97.309(4) An amateur station transmitting a digital signal with any payload: voice, data, television, etc., may use any technique whose technical characteristics have been documented publicly, to the extent that a programmer competent in the art can implement an inter-operable system which decodes the transmitted messages and allows it to be monitored in its entirety. Sufficient intellectual property rights (copyright, patent, etc.) must be granted to allow use of the technique for Amateur Radio communication, both transmission and reception.

My language regarding *payload* above is due to the fact that the current rules regulate signals separately by their payload: a digital voice signal is regarded as radiotelephone, a digital video signal as television. Of course a modern digital signal may carry text, video, television, and any other payload from moment to moment. The proposed rule should apply to *all* digital signals, while without the language regarding *payload*, the language would be considered to apply only to a digital transmission with textual content.

My proposed language is independent of whether the implementation of the monitoring software is Open Source or proprietary.

I ask for sufficient rights to be granted to use the technique for both transmission and reception, rather than simply for the purpose of monitoring. There are two reasons:

1. Any Amateur who is being interfered with should be able to contact the interfering station using the same mode, in order to request that they stop interfering.

2. The potential to actually *use the software in Amateur communications* is required if programmers are to be sufficiently motivated to produce the software. The use for monitoring alone would not motivate many programmers, and thus the self-policing nature of Amateur Radio would be thwarted. The rights concerned here would mostly be patent rights, and copyright of APIs if courts allow those to stand (see https://en.wikipedia.org/wiki/Oracle_America,_Inc._v._Google,_Inc.)

3.2 The PACTOR Issue

One of the main concerns of Radio Amateurs regarding self-policing was that transmissions making use of Pactor 2, 3, and 4 were compressed using a data compression table and algorithm that was not disclosed. This compression obscured the meaning of the text and was effectively a code. The "key" to this code was to own an instance of the rather expensive PACTOR hardware. No other means of decoding was available to Radio Amateurs. Such hardware costs $1600 to $2000 at this writing. Thus, the self-policing operation of Amateur Radio was impeded.

SCS, maker of PACTOR, drove the purchase of additional PACTOR hardware using the fact that *only* a PACTOR hardware system produced by SCS could decode PACTOR 2, 3, and 4 transmissions. Nobody but an owner of their hardware was in posession of the "key" necessary to decode the transmissions. I believe this was a *purposeful* obscuring of the meaning of the transmission, in violation of 97.309(b), for the commercial purpose of selling PACTOR hardware. Thus, I believe that Amateur transmissions using PACTOR 2, 3, and 4 were unlawful. To the extent that SCS encouraged the use of PACTOR 2, 3, and 4 by US Amateurs while it would have been in violation of 97.309(b), I believe their conduct was unlawful.

However, I note that PACTOR devices are sold for use with radio services other than the Amateur service. The PACTOR units are audio devices meant to be connected to an SSB radio. Audio devices are not regulated by FCC, *unless* they are used to modulate a radio. Thus, there were lawful uses for the devices outside of Amateur Radio.

SCS finally disclosed the compression protocol in this document, marked as being created in 2018:
https://www.p4dragon.com/download/PACTOR_Advanced_Data_Compression.pdf

This publication appears to have removed the issue of 97.309(b) violation.

3.3 Issues in Monitoring Automatic and ARQ Systems

It can be *difficult* for a single monitoring station to reliably copy all of the data of an automatic transmission. The destination station has the capability to ask for information to be repeated (this is called “ARQ”), while the monitoring station does not. Because of the nature of data compression, a missed packet can make it impossible to decode a larger part of the transmission. This technical challenge is not sufficient to merit deauthorization of automatic and ARQ systems.

Responsible listening before transmit by an automatic device does not require the automatic system to solve the *hidden node problem* (see https://en.wikipedia.org/wiki/Hidden_node_problem), since conventional manually-operated stations also do not solve it.

3.4 The “National Security” Issue

Many commenters cited a “national security” issue in their comments on 16-239, theorizing drug-running boats using PACTOR. This story was also carried to the wider media: See https://hackaday.com/2018/11/26/fcc-gets-complaint-proposed-ham-radio-rules-hurt-national-security/ , https://www.rrmediagroup.com/News/NewsDetails/NewsID/17667 , and https://www.reddit.com/r/amateurradio/comments/a1av2j/rappaport_suggests_national_security_risks_with/

All of these news stories featured Dr. Theodore Rappaport, who holds station license N9NB, as proponent of the “national security” theory. In investigating the issue, I personally asked Dr. Rappaport to substantiate his claims, via email on November 30, 2018.

Dr. Rapaport asked that I not disclose his “substantiation”. However it was a story of the form “I know a guy, who knows a guy in the government, who says this is a problem”. He did not include any information that I could use to verify his “substantiation”.

I suggested that Dr. Rapaport attempt to substantiate his claims by making a Freedom of Information Act request regarding any actual knowledge within the government of national security risk in use of PACTOR or any other Amateur

Radio operations. I did not receive any indication that such a request has been made.

The comments and news stories promoting the “national security” theory created a political danger for Amateur Radio while, as far as I can determine, no such unlawful operation actually exists.

Many commercial interests desire to take over Amateur frequencies. Giving legislators an excuse to shut Amateur Radio down, in the form of theoretical drug running communications on Amateur frequencies, is a mistake when such a story can not be substantiated.